Public Health Assessment for

BARITE HILL/NEVADA GOLDFIELDS SITE
McCORMICK, McCORMICK COUNTY, SOUTH CAROLINA
EPA FACILITY ID: SCN000407714
JULY 15, 2011

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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PUBLIC HEALTH ASSESSMENT

BARITE HILL/NEVADA GOLDFIELDS SITE

McCORMICK, McCORMICK COUNTY, SOUTH CAROLINA

EPA FACILITY ID: SCN000407714

Prepared by:

U.S. Department of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

STATEMENT OF ISSUES AND BACKGROUND

Statement of Issues

The Agency for Toxic Substances and Disease Registry (ATSDR) prepared this public health assessment to evaluate, based on the information currently available, any known or potential adverse human health hazards related to exposures to chemicals at the Barite Hill/Nevada Goldfields Site. The site, primarily used for gold mining, is located in a remote, rural area of McCormick, South Carolina.

The U.S. Environmental Protection Agency (EPA) proposed the Barite Hill/Nevada Goldfields Site to its National Priorities List (NPL) of hazardous waste sites in September 2008. The site was officially listed on the NPL in April 2009. The NPL is part of the EPA Superfund cleanup process and is primarily intended to guide EPA in determining the hazardous waste sites that warrant further investigation and possible clean-up. ATSDR has become involved with the Barite Hill/Nevada Goldfields Site because Congress mandates that ATSDR conduct public health activities at Superfund sites that EPA proposes to its NPL.

Background

The Barite Hill/Nevada Goldfields Site (referred to in this document as the Barite Hill Site) is located approximately 3 miles southwest of the town of McCormick, South Carolina. Three highways near the site include Highway S-33-30, Highway S-33-44, and Highway S-33-248. The site covers about 795 acres. Mining operations encompassed approximately 135 acres, and the remaining 660 acres served as a buffer zone not to be disturbed beyond their natural state (1). The area surrounding the site is rural, undeveloped, and sparsely populated.

A private groundwater well survey conducted in 2004 indicated that no wells were identified in the immediate area of the site. Only one distant private well was located within 2.5 miles of the site. Homes and businesses in the vicinity of the site receive their drinking water from a public (or municipal) water supply. No public supply wells were located within a 4-mile radius of the Barite Hill Site (1).

Access to the site is restricted by fences, two gates, and natural barriers. However, there has been evidence of the occasional trespasser that may access the site on all terrain vehicles. People also stated they frequently used the property for recreational activities when they were questioned about their activities at the site by EPA (2).

Fishing occurs where Hawe Creek enters Strom Thurmond Lake about 2.2 miles downstream of the Barite Hill Site. According to an EPA report, fish species caught in the area include striped and largemouth bass and flathead catfish. Information on the amount of fish caught on an annual basis was unavailable (2).

The Barite Hill Site was previously owned by Nevada Goldfields, Inc. who operated a gold mining business on the property. The site was actively mined from 1991 to 1995. Some records indicate that minimal silver mining was also conducted at the site. From 1995 until Nevada Goldfields, Inc. filed for Chapter 7 Bankruptcy in 1999, the reclamation of the site was being addressed by Nevada Goldfields, Inc. On July 7, 1999, Nevada Goldfields, Inc. handed the keys to the facility over to the South Carolina Department of Health and Environmental Control (SCDHEC) and abandoned the site (3).

Operations at the site involved the use of a cyanide solution in a heap leach process to extract gold from ore using conventional open pit methods. Fractured rock was crushed into smaller pieces and a dilute cyanide solution was then sprayed over the rock heaps and allowed to percolate thorough the ore which dissolved the gold from the rock and into the solution. The gold-bearing solution (also referred to as pregnant solution) was drained from the heaps and sent to an on-site processing plant. At the processing plant, gold recovery from the process solution began with the adsorption of the dissolved gold onto activated carbon which was then stripped to collect the gold (3).

The site consisted of two open mine pits: the 17-acre Main Pit (located in the northeastern part of the site) and the 4-acre Rainsford Pit (located in the southwest portion of the site). A reusable heap leach facility consisting of an asphalt-lined leach pad, a permanent leach pad, eight ponds, two waste disposal areas, and diversion ditches were used during operations (2). A site map detailing the various areas of the site is located in Figure 1. When the mine was abandoned, the Main Pit flooded. Waste rock surrounding the eastern and southern portions of the Main Pit produced acid drainage into the Main Pit surface water. The Main Pit contains approximately 60 million gallons of water with a historical pH of approximately 2 and a high dissolved metal content (4). Seeps from the Main Pit containing acidic water and dissolved metals have been released to the northern unnamed tributaries of Hawe Creek which borders the pit, depicted as Previous Outfall 3 on Figure 1 (3).

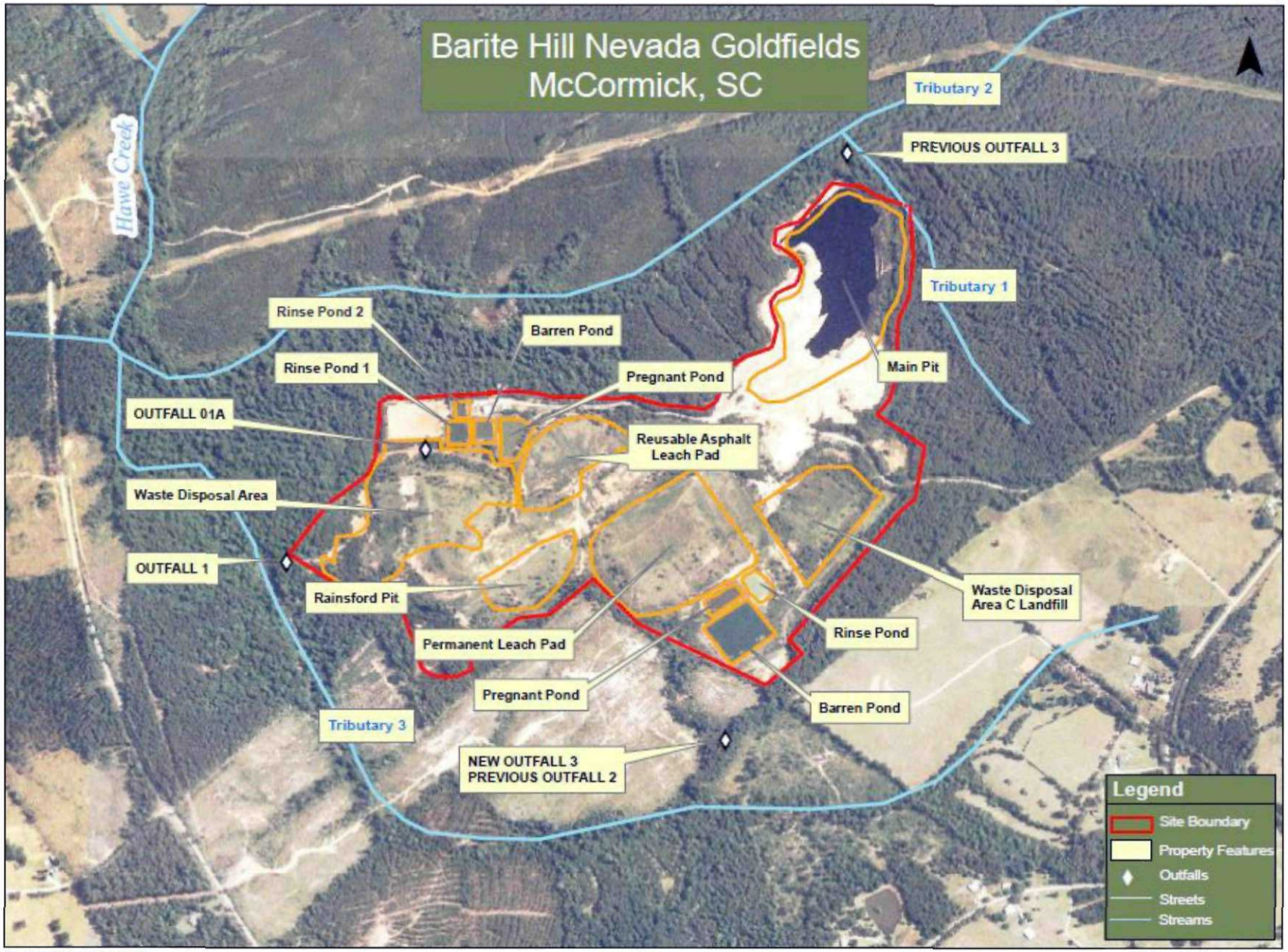


FIGURE 1: SITE MAP

Land Use and Demographics

According to U.S. 2000 Census data, only 17 people live within a half-mile radius while 218 people live within one mile of the site. Approximately 65% (or 11 individuals) of the population within a half-mile of the site are black while 30% (or 5 individuals) are white. Within one mile, 60% of the population (or 130 individuals) are black and 40% of the population (or 86 individuals) are white. While 89 housing units are located within a mile of the site, only 6 housing units are found within a half-mile of the site. Only two children aged 6 years and under are located within a half-mile of the site. Approximately 25 children aged 6 years and under are located within one mile of the site. Additional demographic information for the community in the vicinity of the site is presented in Figure 2.

EPA and SCDHEC Activities (2003 – Present)

Before Nevada Goldfields, Inc. ceased reclamation activities at the site in July 1999, the water in the Main Pit was treated with lime to reduce the acidity. On July 7, 1999, Nevada Goldfields, Inc. handed the keys to the facility over to the South Carolina Department of Health and Environmental Control (SCDHEC) and abandoned the site (3).

In 2003, SCDHEC visited the site and noticed a heavy sulfur odor at the main entrance continuing to the Main Pit area. Testing of the water in the Main Pit indicated a pH of approximately 2.0, considered to be highly acidic. Actions at that time focused on the prevention of acid generation and run-off from the Main Pit to nearby tributaries and impacts to area groundwater (1).

In 2004, SCDHEC conducted additional activities including a Preliminary Assessment/Site Inspection (PA/SI). Surface water and sediment samples collected from the Main Pit, on-site process ponds, surrounding tributaries, and Hawe Creek were analyzed for metals. Sediment samples collected from surrounding tributaries indicated arsenic, barium, cadmium, copper, lead, and zinc at concentrations at least three times greater than levels of metals that naturally occur in that area (also referred to as background levels). Surface water samples from tributaries showed barium, copper, and lead at concentrations at least three times greater than background levels. The PA/SI report identified several areas of concern at the site; however, the Main Pit was identified as having the greatest potential for adverse impacts to groundwater and surface water (1).

Investigation activities continued at the site including a site reconnaissance in January 2007. During this effort by EPA and SCDHEC, a seep from the northern side of the Main Pit was observed to be discharging to the northern unnamed tributary of Hawe Creek. This seep was found to contain high dissolved metal content and was highly acidic (2).

In March 2007, SCDHEC, EPA, and the Bureau of Reclamation conducted an environmental assessment of the site resulting in an EPA emergency response which

included the demolition of a furnace building and neutralization of over 2,000 pounds of acid-producing waste rock adjacent to the Main Pit.

In June 2007, EPA contractors conducted expanded site investigation (ESI) activities to further evaluate the condition of the surface water and sediment associated with the Barite Hill Site. This included the collection of samples from six on-site process ponds, one on-site depression, surrounding tributaries, and Hawe Creek. Tributaries 1, 2, and 3 are tributaries of Hawe Creek (Figure 1). Conclusions of this work indicated that surface water and sediment from each of the surface water bodies sampled contain levels of cadmium, copper, lead, mercury, nickel, selenium, vanadium, zinc, and cyanide which may be of concern for ecological receptors (1). No specific human health conclusions were indicated in the ESI Report for these surface water bodies.

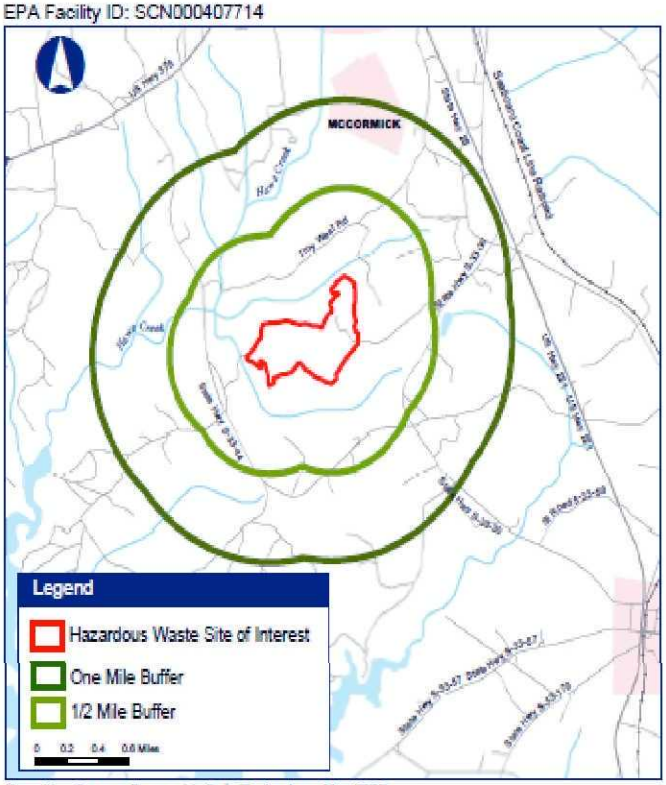
From October 2007 through October 2008, activities involved a cap for the waste rock, Main Pit surface water neutralization, and cyanide deactivation in one of the on-site process ponds. EPA considers their treatment efforts to be successful at neutralizing Main Pit conditions at this time (5).

Currently, EPA is continuing its efforts at the Barite Hill Site and will collect additional environmental data during its Remedial Investigation (RI) which is part of the EPA Superfund process. More information on the EPA Superfund Process and their work at the Barite Hill Site can be found on the following EPA websites.

- Details on the EPA Superfund Process can be found at: http://www.epa.gov/superfund/
- Additional information on EPA's on-going efforts at the Barite Hill Site can be found at: http://www.epa.gov/region4/waste/npl/nplsc/baritehillsc.html

Barite Hill/Nevada Goldfields
McCormick, SC

EPA Facility ID: SCN000407714

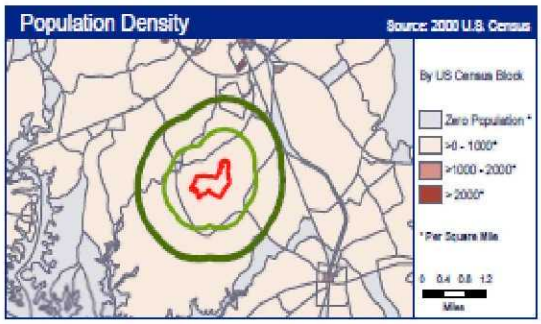


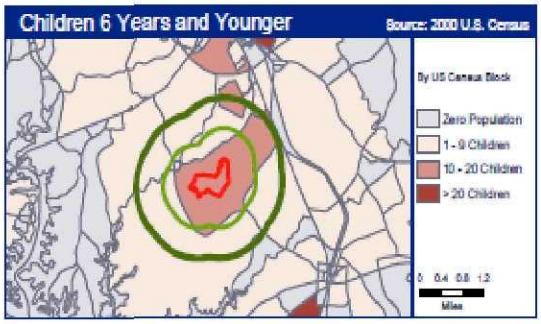
Site Location: McCormick County, SC

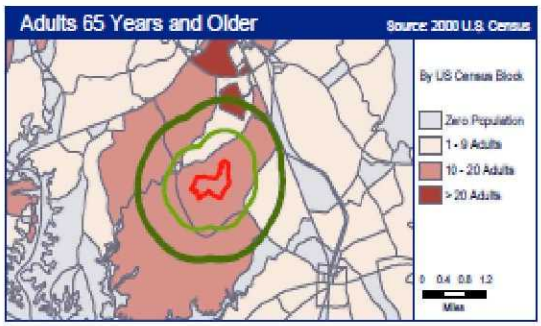
Demographic Statistics Within Area of Concern*	1 mile	1/2 mile
Total Population	218	17
White Alone	86	5
Black Alone	130	11
Am. Indian & Alaska Native Alone	0	0
Asian Alone	1	0
Native Hawaiian & Other Pacific Islander Alone	0	0
Some Other Race Alone	0	0
Two or More Races	1	0
Hispanic or Latino**	0	0
Children Aged 6 and Younger	25	2
Adults Aged 65 & Older	32	2
Females Aged 15 to 44	48	4
Total Housing Units	89	6

Base Map Source: Geographic Data Technology, May 2005.
Site Boundary Data Source: ATSDR Geospatial Research, Analysis, and Services Program, Current as of Generate Date (bottom left-hand corner).
Coordinate System (All Panels): NAD 1983 StatePlane South Carolina FIPS 3900 Feet

Demographics Statistics Source: 2000 U.S. Census
* Calculated using an area-proportion spatial analysis technique
** People who identify their origin as Hispanic or Latino may be of any race.







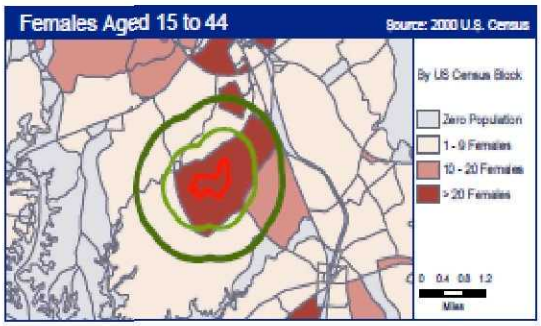


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Figure 2

ENVIRONMENTAL DATA CONSIDERED

As part of this public health assessment, ATSDR considered environmental samples collected from: (1) on-site ponds, nearby tributaries, and Hawe Creek; as well as (2) the Main Pit.

- ATSDR considered the surface water and sediment samples collected by U.S. EPA in June 2007 during ESI activities. Samples collected from Tributary 1, Tributary 2, Tributary 3, an unnamed tributary, and Hawe Creek were reviewed by ATSDR as part of this public health assessment (1). Upon review of the 2007 ESI data and information on the site conditions, it has been determined by ATSDR that people are not likely to come in contact with the chemicals in these areas during swimming. Therefore, these areas are not further evaluated by ATSDR at this time. A detailed discussion of ATSDR's rationale is presented in the Pathway Analysis section of this public health assessment.

- ATSDR also considered surface water samples collected from the Main Pit during 15 sampling events conducted by EPA from October 2007 through November 2009 (4). Although exposure to surface water in the Main Pit is unlikely, ATSDR has determined that it is possible for people to come in contact with chemicals during swimming in the Main Pit. Therefore, the remainder of this public health assessment focuses on evaluating environmental samples collected from the Main Pit and the potential for health impacts.

EPA is currently in the process of collecting additional environmental samples to better understand the surface water, soil, sediment, and groundwater conditions at the site. These data will be summarized in the Remedial Investigation (RI) Report for this site. When available, ATSDR will review the new information and prepare additional public health documents, if the information changes the health conclusions of this document.

PATHWAY ANALYSIS

ATSDR's pathway analysis determines whether people have come into contact with chemicals from a site and whether these contacts were substantial enough to cause harm. The purpose of ATSDR's Pathway Analysis is to focus the public health assessment on the areas of the site that contain chemicals that people may come into contact with, based on the environmental information available. To make this determination, ATSDR identifies exposure pathways or ways in which chemicals associated with the site could enter a person's body.

As outlined in ATSDR's Public Health Assessment Guidance Manual (6), an exposure pathway contains five major elements:

1. a source of contamination,
2. transport through an environmental medium,
3. a point of exposure,
4. a route of exposure, and
5. an exposed population.

If an exposure pathway contains all five elements and exists now or existed in the past, the pathway is considered complete. Completed exposure pathways are evaluated further by ATSDR to determine whether health effects could occur. A potential exposure pathway exists if information on one or more of the five elements is missing or unknown, but exposures may have occurred, are currently occurring, or could occur in the future. An exposure pathway is considered incomplete and is eliminated from further evaluation when one of the five elements is known to be absent (6).

Drinking Water Exposure Pathway

Homes and businesses in the vicinity of the site receive their drinking water from a public water supply which is monitored routinely to ensure that chemicals do not exceed health-based standards. It is important to understand how site conditions may affect private well users in communities impacted by hazardous waste sites as private wells are not routinely monitored by the local municipality and testing is the responsibility of the home owner in most cases. A private drinking water well survey was conducted in 2004 that indicated that no wells were identified in the immediate area of the site. Only one distant private well was located within 2.5 miles of the site. In addition, no public supply wells are located within in 4-mile radius of the Barite Hill Site (1). ATSDR considered this information and determined that the private well exposure pathway is incomplete at this time, based on the available information. However, EPA is currently in the process of collecting groundwater samples as part of its Remedial Investigation (RI). ATSDR will review the new data, when available, and prepare additional health assessment documents, as needed, to evaluate the drinking water pathway if potential exposures are identified.

Surface Soil Exposure Pathway

ATSDR is aware that individuals (likely teenagers) have been reportedly using all-terrain vehicles (or four-wheelers) on the site. Future data that will be collected by EPA is expected to provide ATSDR with the information needed to evaluate the health implications for people who may be exposed to chemicals in dust and soil while riding all-terrain vehicles on the site. Site trespassers also may access the site and walk around on the property (i.e., hiking). Until adequate surface soil data is available from EPA, this pathway is considered a potential exposure pathway which cannot be further evaluated at this time.

Surface Water and Sediment from Tributaries and Hawe Creek Exposure Pathway

ATSDR considered the available surface water and sediment data from Tributaries 1, 2, and 3 as well as Hawe Creek as part of this public health assessment. Although some surface water and sediment samples collected from these areas have been found to contain metal concentrations in excess of normal background and of ecological concern, these surface water bodies are located in extremely remote areas and people do not routinely come into contact with the surface water or sediment in these areas. According to water measurements provided by the SCDHEC, the water levels have ranged from 0.3 feet to approximately 3.2 feet which makes the conditions unlikely for frequent swimming. A beautiful recreational area is located within 2 miles of the site at Strom Thurmond Lake. ATSDR has received several reports from residents and local government officials indicating that people would be unlikely to swim, wade or fish in the areas near the Barite Hill Site and would instead utilize the nearby Strom Thurmond Lake for these types of recreational activities.

The remote areas of Tributaries 1,2,3 and Hawe Creek, as well as their shallow depth, do not make these areas likely places for people to access for swimming or other recreational activities. Therefore, ATSDR has determined this exposure pathway to be incomplete at this time. EPA is continuing its investigation of surface water and sediment in these areas at this time. If additional information becomes available to ATSDR which changes the assumptions of this assessment, further consideration of this pathway by ATSDR will be necessary.

Fish Ingestion Pathway

Some areas of surface water in the vicinity of the Barite Hill Site have been impacted by site activities. In particular, surface water in tributaries near the Main Pit has been found to have high acidity as well as concentrations of metals that are higher than normal background levels. At this time, the impacts to fish and other ecological implications are being considered by the EPA as part of their Remedial Investigation (RI) efforts. While people have not reportedly fished in the surface water on or very near the site, the nearby tributaries connect with Hawe Creek which enters Strom Thurmond Lake approximately 2 miles downstream. People have been known to fish recreationally in Hawe Creek as well as Strom Thurmond Lake. ATSDR does not have the information needed to

evaluate possible impact to humans from consuming fish caught in surface water that may have been impacted by the site. Therefore, this pathway is considered a potential pathway requiring additional information. ATSDR will review and evaluate fish tissue data and other applicable information that is collected by EPA at the site as necessary.

Surface Water from the Main Pit Exposure Pathway

ATSDR has identified surface water from the Main Pit area as the one completed exposure pathway for the Barite Hill Site, based on the environmental data available at this time. While the site is fenced and located in a very remote location, there is evidence that people access the site. The surface water in the Main Pit area is deep enough to support swimming activities although ATSDR has not received any reports of people swimming there. However, ATSDR has applied a very health-protective approach and evaluates the rare occasion of a site trespasser swimming in the Main Pit in this public health assessment. These hypothetical individuals may be/may have been exposed to chemicals in surface water in the Main Pit through incidental (or accidental) ingestion and direct skin contact during swimming.

DISCUSSION

The first step in ATSDR's evaluation process is to select the chemicals of concern, also described as the chemicals that require further evaluation. ATSDR selects chemicals of concern on the basis of whether the maximum detected concentrations of the chemical are found to exceed applicable, health-based comparison values. Here are some important factors to understand about ATSDR's comparison values:

- Chemicals found at levels below the health-based comparison value are not expected to result in health effects.
- Levels of chemicals greater than comparison values do not necessarily mean that adverse health effects will occur. The amount of the chemical, the duration of exposure, the route of exposure (i.e., ingestion, inhalation, and direct skin contact), and the health status of exposed individuals are also important factors in determining the potential for adverse health effects.
- When concentrations of a chemical exceed comparison values, a more detailed assessment of the site-specific exposure factors is necessary to understand if health effects are expected for a particular community.

A complete discussion of ATSDR's evaluation process for chemicals that exceed health-based comparison values is presented in Appendix A of this public health assessment. ATSDR evaluated the available surface water data from the Barite Hill Site Main Pit as part of this public health assessment. Exposures that may occur during swimming include accidentally ingesting a small quantity of water, as well as direct skin contact. ATSDR does not have health-based comparison values for surface water; therefore, the available drinking water comparison values have been used. Typical swimming activities are expected to result in a very small amount of water being consumed in comparison to the amount of water that a person might drink each day from their homes. Therefore, ATSDR's approach is considered very protective of human health. Swimmers may also come in contact with soil and sediment in and around the Main Pit that contain metals. However, ATSDR does not have data on the chemical concentrations of sediment or surface soil in these areas at this time.

ATSDR has performed two drinking water comparisons to evaluate the conditions of the surface water in the Main Pit. First, ATSDR compared the surface water metals concentrations in the Main Pit before any neutralization treatment of the Main Pit began. These levels were reported during sampling of the Main Pit in October 2007 and are presented in Table 1. The second comparison performed by ATSDR considered the highest levels of metals detected after the treatment for high acidity began. These values are reported in Table 2 and are based on data collected during 15 sampling events from June 2008 to November 2009.

Table 1. Surface Water Samples Before Treatment for High Acidity: Comparison of metal concentrations in the Main Pit Area with Health-Based Comparison Values

Metal	October 2007 Sampling Pre-treatment (mg/L)	Drinking Water Comparison Value (mg/L)	Comparison Value Reference	Exceeds Comparison Value & Requires Further Evaluation?
Aluminum	224	10	Chronic EMEG[1]	**Yes**
Antimony	0.02	0.004	RMEG[2]	**Yes**
Arsenic	0.968	0.00002	CREG[3]	**Yes**
Cadmium	1.57	0.001	Chronic EMEG[1]	**Yes**
Chromium	0.141	0.01	Chronic EMEG[1]	**Yes**
Copper	287	0.1	Inter. EMEG[4]	**Yes**
Iron	1,150	NA	Essential Nutrient	NA
Lead	0.161	0.015	EPA Action Level[5]	**Yes**
Manganese	13.6	0.5	RMEG[2]	**Yes**
Nickel	0.404	0.2	RMEG[2]	**Yes**
Selenium	0.23	0.05	EMEG[1]/RMEG[2]	**Yes**
Zinc	40.2	3	EMEG[1]/RMEG[2]	**Yes**

NA – Not Applicable

[1]Chronic Environmental Media Evaluation Guides (or Chronic EMEGs) are comparison concentrations below which adverse non-cancer health effects are not expected from long-term (over one year) exposure. These values are derived by ATSDR from its toxicological profiles.

[2]Reference Media Evaluation Guides (or RMEGs) are comparison concentrations below which adverse non-cancer health effects are not expected to occur. These values are derived from EPA's Oral Reference Doses (or RfDs).

[3]Cancer Risk Evaluation Guides (or CREGs) are comparison concentrations that are used to identify concentrations of cancer-causing substances that are unlikely to result in an increase of cancer rates in an exposed population.

[4]Intermediate Environmental Media Evaluation Guides (or Inter. EMEGs) are comparison concentrations below which adverse non-cancer health effects are not expected from intermediate exposures (15-365 days). These values are derived by ATSDR from its toxicological profiles.

[5] EPA Action Levels are the levels of a chemical which, if exceeded, triggers drinking water system treatment or other requirements.

Table 2. Surface Water Samples Following the Start of Treatment for High Acidity: Comparison of maximum detected metal concentrations in the Main Pit Area with Health-Based Comparison Values. Data from 15 Sampling Events (June 2008 – November 2009)

Metal	Maximum Detected Concentration (mg/L)	Drinking Water Comparison Value (mg/L)	Comparison Value Reference	Exceeds Comparison Value & Requires Further Evaluation?
Aluminum	0.622	10	Chronic EMEG[1]	No
Antimony	0.257	0.004	RMEG[2]	**Yes**
Arsenic	Not detected	0.00002	CREG[3]	No
Cadmium	Not detected	0.001	Chronic EMEG[1]	No
Chromium	0.0015	0.01	Chronic EMEG[1]	No
Copper	0.145	0.1	Inter. EMEG[4]	**Yes**
Iron	322	NA	Essential Nutrient	NA
Lead	0.0427	0.015	EPA Action Level[5]	**Yes**
Manganese	11.7	0.5	RMEG[2]	**Yes**
Nickel	0.163	0.2	RMEG[2]	No
Selenium	0.028	0.05	EMEG[1]/RMEG[2]	No
Zinc	1.44	3	EMEG[1]/RMEG[2]	No

NA – Not Applicable

Maximum detected concentrations based on the results of the following 15 sampling events: June 2008, July 2008, August 2008, November 2008 (2 events), December 2008, January 2009, February 2009, April 2009, May 2009, June 2009, July 2009, August 2009, September 2009, and November 2009.

[1]Chronic Environmental Media Evaluation Guides (or Chronic EMEGs) are comparison concentrations below which adverse non-cancer health effects are not expected from long-term (over one year) exposure. These values are derived by ATSDR from its toxicological profiles.

[2] Reference Media Evaluation Guides (or RMEGs) are comparison concentrations below which adverse non-cancer health effects are not expected to occur. These values are derived from EPA's Oral Reference Doses (or RfDs).

[3]Cancer Risk Evaluation Guides (or CREGs) are comparison concentrations that are used to identify concentrations of cancer-causing substances that are unlikely to result in an increase of cancer rates in an exposed population.

[4]Intermediate Environmental Media Evaluation Guides (or Inter. EMEGs) are comparison concentrations below which adverse non-cancer health effects are not expected from intermediate exposures (15-365 days). These values are derived by ATSDR from its toxicological profiles.

[5] EPA Action Levels are the levels of a chemical which, if exceeded, triggers drinking water system treatment or other requirements.

The term pH indicates the acidity or alkalinity of a solution on a scale ranging from approximately 0 to 14. As a frame of reference, pure water has a pH of approximately 7. When an acid is dissolved in water the pH will be less than 7 (or acidic) and when a base (or alkali) is dissolved in water the pH will be greater than 7. Table 3 presents a summary of the available pH readings from surface water in the Main Pit from July 2007 to September 2009 (4,7). Table 3 also presents common products with similar pH as a frame of reference. While serious health problems are not likely to be associated with contact with the pH levels measured at the site, irritation to skin and eyes may be possible at acidic pH levels.

Table 3. Historical Main Pit pH Readings (July 2007-September 2009) and Common Products with Similar pH

Reading Date	pH at 1 meter from surface	pH at 2 meters from surface	Common Products with Similar pH
July 2007	2.4	NA	Vinegar
November 2008	4.4	4.6	Tomato Juice
December 2008	4.9	5.0	Tomato Juice
April 2009	5.1	5.2	Coffee
May 2009	3.1	5.1	Orange Juice/Coffee
June 2009	5.2	5.2	Coffee
July 2009	8.6	8.4	Sea Water
August 2009	6.0	6.0	Milk
September 2009	6.1	6.0	Milk

NA – Not Available

Note: All readings, with the exception of July 2007, are referenced in December 2009 letter report from Oneida Total Integrated Enterprises (OTIE) to EPA (4). The July 2007 reading was indicated in the July 5, 2007 letter report to EPA from the South Carolina Department of Health and Environmental Control (7). Common product pH information was obtained from the National Aeronautics and Space Administration (NASA) website (8).

Before treatment of the Main Pit water for high acidity, levels of several metals (aluminum, antimony, arsenic, cadmium, chromium, copper, lead, manganese, nickel, selenium, and zinc) were found at concentrations that exceed drinking water comparison values (Table 1). After the start of treatment of the Main Pit, concentrations of most metals in the water decreased significantly. In the following 15 sampling events, conducted from June 2008 to November 2009, only levels of antimony, copper, lead, and manganese were found to exceed comparison values during any sampling event (Table 2). A historical evaluation of the pH in the Main Pit indicates that the pH of the water was increased (indicating decreasing acid content) as a result of treatment (Table 3). It appears that the treatment of water for acidity has also significantly reduced the

concentrations of dissolved metals in the water of the Main Pit for many of the detected metals.

Using the results of the health-based comparison value screening, ATSDR determined that further assessment is necessary to evaluate potential exposures to individuals that swim or may have swam in the Main Pit surface water. Therefore, the following two evaluations are the focus of this public health assessment:

- An evaluation of all metals detected above health-based comparison values in the Main Pit prior to the start of treatment using surface water samples collected in October 2007.
- An evaluation of antimony, copper, lead, and manganese concentrations detected above health-based comparison values in the Main Pit using surface water samples collected during 15 sampling events occurring from June 2008 through November 2009.

PUBLIC HEALTH IMPLICATIONS

For chemical concentrations found to exceed comparison values, ATSDR performed calculations referred to as exposure doses to assess non-cancer health impacts as well as cancer risk estimates. These calculations estimate the amount of the chemicals of concern that individuals may be exposed to and the likelihood of cancer and non-cancer health impacts. The calculations are based on the types of site-specific activities that individuals may be involved with that result in contact with chemicals in the surface water. In the event that calculated exposure doses exceed established health guidelines (e.g., ATSDR Minimal Risk Levels or EPA Reference Doses), an in-depth toxicological evaluation is the next step necessary to better understand the likelihood of health effects.

In the past, trespassers may have been exposed to chemicals in surface water in the Main Pit through accidental ingestion and possibility by direct skin contact during swimming. In order to evaluate these potential exposures, ATSDR considers the available site-specific information and makes assumptions about how much and how often people might be exposed to the chemicals found in the areas that they access.

Many physical hazards exist at the site and "No Trespassing" signage is posted. While trespassing and swimming in the Main Pit water is illegal and not recommended, it may have occurred or be occurring at the site. For the Barite Hill Site, trespassers are considered to be older children or young adults, aged 11 to 21 and weighing approximately 57 kilograms (or 125 pounds), who accessed the site and swam in surface water from the Main Pit. ATSDR assumed that these persons swam two times per month during the five warm months of the year (or 10 days per year). While swimming, individuals were assumed to accidentally drink 0.0125 liters of water from the Main Pit. Trespassers have been evaluated for a 10-year exposure duration. This is considered to be a highly conservative assumption, particularly if an individual had an early irritation reaction from swimming in the water making them less likely to swim in the Main Pit again. Upon closer review of the site conditions, ATSDR has not calculated exposure doses for direct skin exposure. The swim duration was likely to be very short and metals are not easily absorbed into the skin. Therefore, the ingestion of water was the primarily exposure route considered by ATSDR in the remainder of this public health assessment.

Additional specific information on the exposure scenarios, assumptions and calculations used to estimate exposures to chemicals in surface water in the Main Pit are discussed in Appendix A of this public health assessment.

As previously discussed, the findings of the health-based comparison (Tables 1 and 2) indicated that further evaluation of the following metals in Main Pit surface water was necessary to understand their potential for health impacts because they were found at levels that exceeded health-based drinking water comparison values:

- **Aluminum, antimony, arsenic, cadmium, chromium, copper, lead, manganese, nickel, selenium,** and **zinc** concentrations detected in Main Pit surface water prior to the start of treatment, using data collected from October 2007.
- **Antimony, copper, lead,** and **manganese** detected in Main Pit surface water after treatment for acidity began, using data collected from June 2008 through November 2009.

Therefore, a complete assessment of the potential for exposure to the identified metals to result in both cancer and non-cancer health effects has been conducted in this public health assessment.

Non-cancer Effects Evaluation

ATSDR calculated exposure doses for 10 of the 12 metals detected in surface water to determine the potential for non-cancer health effects from incidental ingestion. Exposure doses were not calculated for iron and lead. However, qualitative discussions of these metals are presented. Exposure doses are expressed in units of milligrams per kilograms per day (mg/kg/day). The calculated exposure doses were compared with health-based guidelines (i.e., ATSDR Oral Minimal Risk Levels or EPA Oral Reference Doses), when available. Calculated exposure doses that are below health guidelines indicate that health effects are not expected. When calculated exposure doses for a particular chemical exceed the health-based guidelines, it does not necessarily indicate that health effects will occur. Instead, a more in-depth look at the toxicological data available for the chemical is needed to fully evaluate the exposure. ATSDR's guidelines are described in more detail in Appendix A of this public health assessment.

Summaries of the calculated exposure doses for metals detected above comparison values in pre-treated Main Pit surface water and following the start of treatment for acidity are presented in Tables 4 and 5, respectively. A discussion of the individual metals and exposure doses follows these tables.

Table 4. Calculated Exposure Doses for Incidental Ingestion While Swimming; Main Pit Surface Water, Before the Start of Treatment for Acidity

Metal	Exposure Dose (mg/kg/day)	Selected Health Guideline (mg/kg/day)	Health Guideline Source	Exceeds Health Guideline?	Non-Cancer Health Effects Conclusion
Aluminum	0.001	1.0	Chronic MRL[1]	No	Non-Cancer Health Effects are Not Expected. No Further Evaluation is Needed for Any of the Detected Metals.
Antimony	0.0000001	0.0004	EPA RfD[2]	No	
Arsenic	0.000006	0.0003	MRL[1]/RfD[2]	No	
Cadmium	0.000009	0.0001	Chronic MRL	No	
Chromium	0.0000009	0.001	Chronic MRL	No	
Copper	0.002	0.01	Inter. MRL[3]	No	
Iron	NA	NA	NA	NA	
Lead	NA	NA	NA	NA	
Manganese	0.00008	0.05	EPA RfD	No	
Nickel	0.000002	0.02	EPA RfD	No	
Selenium	0.000001	0.005	MRL[1]/RfD[2]	No	
Zinc	0.0002	0.3	MRL[1]/RfD[2]	No	

NA – Not Applicable

[1]ATSDR Oral Chronic Minimal Risk Level (or ATSDR Chronic MRL) is an estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful non-cancer health effects. These MRLs are calculated for oral exposures occurring over a period of 365 days or longer.

[2]EPA Oral Reference Dose (or EPA RfD) is an estimate of the daily lifetime dose of a substance that is unlikely to cause harm in humans and has incorporated uncertainty or safety factors.

[3]ATSDR Oral Intermediate Minimal Risk Level (or Inter. MRL) is an estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful non-cancer health effects. These MRLs are calculated for oral exposures occurring over a period greater than 14 days, but less than 365 days.

Table 5. Calculated Exposure Doses for Incidental Ingestion While Swimming; Main Pit Surface Water, After the Start of Treatment for Acidity

Metal	Exposure Dose (mg/kg/day)	Selected Health Guideline (mg/kg/day)	Health Guideline Source	Exceeds Health Guideline?	Non-Cancer Health Effects Conclusion
Antimony	0.000002	0.0004	EPA RfD[1]	No	Non-Cancer Health Effects are Not Expected; No Further Evaluation is Needed for Any of the Detected Metals
Copper	0.0000009	0.01	Inter. MRL[2]	No	
Lead	NA	NA	NA	NA	
Manganese	0.00007	0.05	EPA RfD[1]	No	

NA – Not Applicable

[1]EPA Oral Reference Dose (or EPA RfD) is an estimate of the daily lifetime dose of a substance that is unlikely to cause harm in humans and has incorporated uncertainty or safety factors.

[2]ATSDR Oral Intermediate Minimal Risk Level (or Inter. MRL) is an estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful non-cancer health effects. These MRLs are calculated for oral exposures occurring over a period greater than 14 days, but less than 365 days.

Many physical hazards exist at the site and people are urged not to trespass on site property. Based on the calculated exposure doses, individuals who swam in the Main Pit surface water were exposed to very low doses of metals. ***While trespassing and swimming in the Main Pit water is illegal and not recommended, ATSDR's non-cancer health effects evaluation indicates levels of metals in the Main Pit do not pose a public health hazard to those who may have accidentally ingested small amounts of surface water during swimming before and after the start of treatment for acidity.***

Discussion of the exposures associated with each of the detected metals before and after the start of treatment is presented in the following text. Brief summaries of the toxicological effects based on the available scientific literature are presented and intended to provide general information for each of the chemicals. Please note that the health effects discussed in the available scientific literature have occurred primarily in animal and occupational studies following exposures to metals that are much greater than those associated with swimming in the Main Pit.

Aluminum is the most abundant metal in the earth's crust. It is light in weight and silvery-white in appearance. Aluminum is not easily absorbed by the body. Only small amounts that people may inhale, ingest, or have skin contact with will enter the bloodstream. Most notably, studies of very high exposures to aluminum have shown neurological and respiratory effects in animals and humans (9).

The calculated exposure dose for ingestion of aluminum for trespassers while swimming (pre-treatment) is 0.001 mg/kg/day, which does not exceed the selected health guideline of ATSDR's Oral Chronic Minimal Risk Level of 1.0 mg/kg/day. Aluminum concentrations were not detected above the selected comparison screening value in surface water collected after the start of treatment. ***Therefore, ATSDR concludes that non-cancer health effects are not expected from aluminum exposures while swimming in Main Pit surface water before treatment or after the start of treatment for acidity.***

Antimony is a silvery-white metal that is also found in the earth's crust. When mixed with other metals into alloys, it is used in batteries, solder, and pipe metal. It is also used in paints, ceramics, and fireworks. Antimony-containing medicines have been used to successfully treat patients infected with parasites. Breathing very high levels of antimony can cause irritation of the eyes and lungs, as well as gastrointestinal effects. Heart, liver, kidney, and reproductive damage have also been observed in studies of animals who breathed very high levels of antimony. People who ingested large amounts of antimony have reportedly experienced vomiting. Animal studies report possible liver damage and blood changes from ingesting very high doses of antimony (10).

The calculated exposure dose for ingestion of antimony for trespassers while swimming, pre-treatment, is 0.0000001 mg/kg/day and after the start of treatment is 0.000002 mg/kg/day, which do not exceed the selected health guideline of EPA's Oral Reference Dose of 0.0004 mg/kg/day. ***Therefore, ATSDR concludes that non-cancer health effects are not expected from antimony exposures while swimming in Main Pit surface water before treatment or after the start of treatment for acidity.***

Arsenic is a naturally occurring element that has also been used historically in many pesticides and wood treatment. Fish and shellfish can accumulate arsenic. However, most of the arsenic in fish is in a form that is found to be much less toxic than other arsenic forms in the environment. Ingesting arsenic has been associated with gastrointestinal effects and disruptions in blood cell production. Long-term exposure to arsenic through ingestion is also associated with a pattern of skin changes as well as an increased risk for liver, bladder, and lung cancers (11). A more detailed discussion of arsenic and cancer is presented in the Cancer Evaluation section of this public health assessment.

The calculated exposure dose for ingestion of arsenic for trespassers while swimming (pre-treatment) is 0.000006 mg/kg/day, which does not exceed the selected health guideline of ATSDR's Oral Chronic Minimal Risk Level and the EPA Oral Reference Dose of 0.0003 mg/kg/day. Arsenic concentrations were not

detected in any surface water samples collected after the start of treatment. ***Therefore, ATSDR concludes that non-cancer health effects are not expected from arsenic exposures while swimming in Main Pit surface water before treatment or after the start of treatment for acidity.***

Cadmium is found widely in soils and rocks. Cadmium does not corrode easily and has many uses, including batteries, pigments, metals coatings, and plastics. It is possible for cadmium to be taken up by fish, plants, and animals in the environment. Long-term exposure to cadmium in air, food, or water has been associated with kidney disease, as well as lung damage and fragile bones. Eating food or drinking water with very high levels can also cause gastrointestinal effects. Inhalation of cadmium has been associated with cancer; however, ingestion of cadmium has not been determined to cause cancer (12).

The calculated exposure dose for ingestion of cadmium for trespassers while swimming (pre-treatment) is 0.000009 mg/kg/day, which does not exceed the selected health guideline of ATSDR's Oral Chronic Minimal Risk Level of 0.0001 mg/kg/day. Cadmium concentrations were not detected in surface water samples collected after the start of treatment. ***Therefore, ATSDR concludes that non-cancer health effects are not expected from cadmium exposures while swimming in Main Pit surface water before treatment or after the start of treatment for acidity.***

Chromium is an element found in rocks, animals, plants, and soil. It can exist in several different forms: elemental, trivalent, and hexavalent chromium. Elemental chromium is used for making steel. Both trivalent and hexavalent chromium are used for chrome plating, dyes and pigments, leather tanning, and wood preserving. Trivalent chromium is an essential nutrient. Fish do not accumulate much chromium from their surrounding water body. Breathing high concentrations of hexavalent chromium has been associated with respiratory effects, including lung cancer in humans. Ingestion of hexavalent chromium has been associated with stomach and small intestine impacts, as well as anemia. Trivalent chromium is considered much less toxic and is not associated with as serious health impacts as hexavalent chromium. Sensitive individuals have been found to have allergic reactions to trivalent and hexavalent chromium following skin contact (13).

ATSDR does not have sampling information to indicate whether the chromium levels in surface water in the Main Pit are present as hexavalent or trivalent chromium. For health protectiveness, ATSDR applied the health guidelines for the hexavalent chromium, considered to have greater toxicity than trivalent chromium. The calculated exposure dose for ingestion of chromium for

trespassers while swimming (pre-treatment) is 0.0000009 mg/kg/day, which does not exceed the selected health guideline of ATSDR's Oral Chronic Minimal Risk Level of 0.001 mg/kg/day. Chromium concentrations were not detected above the selected comparison screening value in surface water collected after the start of treatment. ***Therefore, ATSDR concludes that non-cancer health effects are not expected from chromium exposures while swimming in Main Pit surface water before treatment or after the start of treatment for acidity.***

Copper is a metal that occurs naturally in the environment and also in plants and animals. Low levels of copper are essential for maintaining good health. Copper is used to make many different kinds of products like wire, plumbing pipes, and sheet metal. It is also used for mildew treatment and as a preservative for wood, leather, and fabrics. Ingestion of high levels of copper has been associated with nausea, vomiting, diarrhea, and damage to the liver and kidneys. According to the available scientific literature, copper exposure has not been associated with cancer (14).

The calculated exposure dose for ingestion of copper for trespassers while swimming, pre-treatment, is 0.002 mg/kg/day and after the start of treatment is 0.0000009 mg/kg/day, which do not exceed the selected health guideline of ATSDR's Oral Intermediate Minimal Risk Level of 0.01 mg/kg/day. ***Therefore, ATSDR concludes that non-cancer health effects are not expected from copper exposures while swimming in Main Pit surface water before treatment or after the start of treatment for acidity.***

Iron is an abundant naturally-occurring metal that is also an essential nutrient for all forms of life. It has been used in pigments, drugs, agriculture, nutrition, and leather tanning (15). Health-based comparison values are not available for iron, therefore, iron exposure doses were not calculated for comparison. EPA has established a Secondary Maximum Contaminant Level (or SMCL) for iron of 0.3 mg/L for drinking water supplies, based on aesthetic issues such as rusty color, metallic taste, reddish staining of clothing washed in water (16). While iron levels measured in the surface water in the Main Pit has exceeded EPA's SMCL, the Main Pit surface water is not used as a drinking water source and aesthetic issues are not an issue. Exposure to iron while swimming is expected to be very minimal and infrequent. ***Therefore, ATSDR concludes that non-cancer health effects are not expected from iron exposures while swimming in Main Pit surface water before treatment or after the start of treatment for acidity.***

Lead is a naturally-occurring bluish-gray metal that is found in small amounts in the earth's crust. Lead in the environment is the result of burning of fossil fuels, mining, and manufacturing. Lead is used in the production of batteries, solder

and pipes, as well as ammunition. Because of health concerns, the use of lead in some consumer products has been dramatically reduced. Its use as a gasoline additive was reduced gradually in 1973 and completely banned in the U.S. in 1996.

Long-term exposure to high levels of lead via ingestion and inhalation may impact the nervous system, kidneys, reproductive, and other systems of the body. Young children and the developing fetus are particularly sensitive to the effects of the lead exposure. Reduced growth, difficulties in learning, gastrointestinal effects, and anemia are among the adverse impacts observed among those exposed to high levels of lead in utero or as a young child. There is some evidence of cancer in animals following exposures to lead in laboratory studies. While cancer impacts are possible, the evidence in humans is limited to high level exposures to workers and is less conclusive (17, 18). A more detailed discussion of cancer is presented in the Cancer Evaluation section of this public health assessment.

Low levels of lead have been detected in surface water samples collected from the Main Pit pre-treatment and after the start of treatment. The pre-treatment lead concentration in surface water collected during the October 2007 sampling was 0.161 mg/L, which exceeds the comparison value selected in this public health assessment of EPA's Action Level of 0.015 mg/L for drinking water systems. Lead sampling results are available for 11 events after the start of treatment (June 2008 to June 2009). Lead was not detected in six of the eleven samples. Of the five samples with detections of lead, only 3 samples were found to have lead at levels above the EPA Action Level of 0.015 mg/L.

Trespassers who swim or who have swam in the Main Pit surface water are not expected to be exposed to levels of lead that can harm their health. The selected comparison value for lead, the EPA Action Level, does not indicate a level that causes health impacts. Rather, it is a level at which EPA requires public drinking water systems who have lead concentrations greater than 0.015 mg/L in more than 10% of the customer tap water samples to undertake a number of additional actions to control corrosion of pipes and work with the public to determine if replacement of lead-containing plumbing is recommended (19). The amount of water the occasional trespasser ingests accidentally during swimming is very low (or 0.0125 liters) compared with the amount of water that individuals drink in their homes (2 liters for adults; 1 liter for children). Based on lead levels measured in samples collected from the Main Pit and the infrequent swimming activities of possible trespassers, lead exposures are considered to be minimal. ***Therefore, ATSDR concludes that non-cancer health effects are not expected from lead exposures while swimming in Main Pit surface water before treatment or after the start of treatment for acidity.***

Manganese is a naturally-occurring metal that is required in small amounts for human health. Manganese is used in steel production and may also be added to gasoline to improve its octane rating. In terms of its toxicity, workers exposed to high levels of manganese experienced significant nervous system effects. Both impacts to the nervous and reproductive systems have been observed in study animals exposed to very high doses via ingestion. Developmental effects have been reported in human and animal studies. Inhalation of high levels of manganese has been associated with lung cancer in occupational and animal studies, although manganese has not been associated with cancer via ingestion (20).

The calculated exposure dose for ingestion of manganese for trespassers while swimming, pre-treatment, is 0.00008 mg/kg/day and after the start of treatment is 0.00007 mg/kg/day, which do not exceed the selected health guideline of EPA's Oral Reference Dose of 0.05 mg/kg/day. ***Therefore, ATSDR concludes that non-cancer health effects are not expected from manganese exposures while swimming in Main Pit surface water before treatment or after the start of treatment for acidity.***

Nickel is an abundant, silvery-white natural element that is used to make stainless steel and other metal alloys. When combined with other metals during processing, it can be used to make coins, jewelry, batteries, and catalysts for chemical reactions. The most common health effect associated with nickel exposure is allergic reaction, as approximately 10-20% of the population is sensitive to nickel. Workers who inhale high levels of nickel have reportedly experienced chronic bronchitis and reduced lung function. People who drank high concentrations of nickel reported gastrointestinal discomfort, as well as blood and kidney effects. Animal studies have indicated lung disease and effects on the stomach, blood, liver, kidney, as well as immune, reproductive and developmental effects (21).

The calculated exposure dose for ingestion of nickel for trespassers while swimming (pre-treatment) is 0.000002 mg/kg/day, which does not exceed the selected health guideline of EPA's Oral Reference Dose of 0.02 mg/kg/day. Nickel concentrations were not detected above the selected comparison screening value in surface water collected after the start of treatment. ***Therefore, ATSDR concludes that non-cancer health effects are not expected from nickel exposures while swimming in Main Pit surface water before treatment or after the start of treatment for acidity.***

Selenium is a mineral element that is widely distributed in most rocks and soil. In its pure form, it exists as metallic gray to black hexagonal crystals, but is usually combined with other elements in nature. Selenium is used in the electronics and glass industry, in paints, plastics, and rubber, as well as in nutritional supplements. Selenium is a trace mineral that is needed in small amounts for good health. High oral exposures occurring over a short time have been associated with nausea, vomiting, and diarrhea. Long-term exposures to high doses of selenium via ingestion have been associated with a disease called selenosis and include symptoms such as hair loss, nail brittleness, and neurological effects (22).

The calculated exposure dose for ingestion of selenium for trespassers while swimming (pre-treatment) is 0.000001 mg/kg/day, which does not exceed the selected health guideline of ATSDR's Oral Chronic Minimal Risk Level and EPA's Oral Reference Dose of 0.005 mg/kg/day. Selenium concentrations were not detected above the selected comparison screening value in surface water collected after the start of treatment. ***Therefore, ATSDR concludes that non-cancer health effects are not expected from selenium exposures while swimming in Main Pit surface water before treatment or after the start of treatment for acidity.***

Zinc is a bluish-white shiny metal that is one of the most common elements in the earth's crust. Zinc has many commercial uses as coatings to prevent rust, in batteries, and mixed with other metals to make alloys. Zinc compounds are widely used in industry to make paint, rubber, dyes, and wood preservatives. Zinc is an essential nutrient, but ingestion of zinc at 10-15 times greater than the amount needed for good health has been associated with cramps, nausea, and vomiting. While high levels of zinc were observed to have reproductive effects in animal studies, it is unclear whether these effects may occur among humans. Animals experienced skin irritation when zinc solutions were applied, and therefore, skin impacts are possible for humans also (23).

The calculated exposure dose for ingestion of zinc for trespassers while swimming (pre-treatment) is 0.0002 mg/kg/day, which does not exceed the selected health guideline of ATSDR's Oral Chronic Minimal Risk Level and EPA's Oral Reference Dose of 0.3 mg/kg/day. Zinc concentrations were not detected above the selected comparison screening value in surface water collected after the start of treatment. ***Therefore, ATSDR concludes that non-cancer health effects are not expected from zinc exposures while swimming in Main Pit surface water before treatment or after the start of treatment for acidity.***

In conclusion, ATSDR has determined that trespassers, who swam in the Main Pit surface water, prior to the start of treatment, may have experienced irritation to the skin and eyes due to the acidity of the water. As treatment neutralized the surface water in the Main Pit, the possibility of irritation effects would have been less likely. ATSDR also concludes from further assessment of the metals detected in the surface water in the Main Pit, that long-term adverse non-cancer health effects are not likely for trespassers who swam in the Main Pit before the start of treatment or after the start of treatment of the water for high acidity.

Cancer Evaluation

Only some chemicals found in surface water in the Main Pit have been associated with cancerous effects in scientific studies. The potency of a chemical to result in cancer and the route for which this may occur (ingestion or inhalation) varies by chemical. Of the metals detected in surface water in the Main Pit, only arsenic and lead have been associated with cancer via the ingestion exposure route. Arsenic, cadmium, hexavalent chromium, and lead have been associated with cancer via the inhalation route. As previously discussed, inhalation exposures are highly unlikely for trespassers who swim in the Main Pit, and therefore, are not evaluated in this public health assessment. However, ATSDR completed a cancer assessment of possible exposures of trespassers to arsenic and lead during occasional swimming in the Main Pit surface water.

Arsenic and Cancer - A review of the toxicological studies of arsenic indicate that ingestion may be associated with cancerous effects in human and animal studies, including liver, bladder, and lung cancers (11). ATSDR considers similar exposure assumptions as those for calculating non-cancer exposure doses. However, EPA's cancer slope factors were applied to the calculated exposure doses to estimate the likelihood of an increased cancer risk (24). Cancer risk estimates are expressed as the risk of an individual developing cancer over his or her lifetime. It should be noted that an increased cancer risk is not a specific estimate of expected cancers among people living in the community near the Barite Hill Site. Rather, it is an estimate of the increase in the probability that a person may develop cancer sometime during his or her lifetime following exposure to a particular chemical. These numeric estimates provide scientists with the information that they consider when deciding if public health actions are needed to protect public health. The recommendations of many scientists, including ATSDR and EPA, has been that an increased lifetime cancer risk of one in one million (1×10^{-6}) or less is generally considered an insignificant increase in cancer risk. Cancer risk less than 1 in 10,000 (or 1×10^{-4}) is not typically considered a health concern. Cancer risk greater than 1 in 10,000 may pose a significant concern regarding the potential for cancerous effects.

ATSDR's evaluation of cancer risk indicates that ingestion of arsenic during swimming poses an insignificant increased risk for cancer, using EPA's oral cancer slope factor of 1.5 $(mg/kg/day)^{-1}$ (24). Numerically, the calculated cancer risk associated with pre-treatment water conditions was estimated to be 1 extra cancer cases per million people exposed (or 1.2×10^{-6}), which is considered to be very low and is not at levels of public health concern. Arsenic was not detected in surface water samples collected following the start of treatment for acidity so no cancer risk was calculated for exposures following the start of treatment, and additional arsenic cancer risk is not expected.

Lead and Cancer – Based on the evidence of cancer among animals exposed to high levels of lead in laboratory studies, EPA, the National Toxicology Program (NTP), and the International Agency on Cancer Research (IARC) have indicated that lead is probably a human carcinogen. Much of the information regarding lead exposures and cancer in humans is derived from studies of workers exposed to high levels of lead. Often the results of the worker studies were inconsistent in follow-up studies, therefore, making the relationship between human exposure to lead and the development of cancer less clear. The available scientific literature on ingestion of high doses of lead by laboratory animals indicates that lead causes cancer, primarily cancer of the kidneys (17, 18).

EPA has not developed a cancer slope factor due to the uncertainties associated with cancer risk and lead exposure. Age, health, nutritional status, and other factors have a great influence on the absorption and potential impact of lead in humans (18). Therefore, ATSDR could not calculate a cancer risk estimate for lead. Based on the limited exposures to lead that may be associated with occasional swimming, the likelihood of cancerous effects is considered to be very low and insignificant.

In conclusion, ATSDR has determined that the increased cancer risk from swimming in the Main Pit at the Barite Hill Site is very low.

ATSDR's Involvement with the Community

A major goal of ATSDR's work is to encourage communication with the public throughout each phase of the public health assessment process. Community input helps ATSDR to create public health documents that accurately reflect how people in this community may have come into contact with chemicals from the site. Community feedback can also help ATSDR to understand individual health concerns as they relate to the site. ATSDR's partnership with the community begins as site-related community health concerns are gathered and continues throughout the public comment period on public health assessment documents. Even upon completion of a public health assessment, members of the community may contact ATSDR to discuss any on-going concerns regarding the site or to inquire about other site-related activities. Two important ways that ATSDR invites the community to share their health concerns related to the site and input on the public health assessment are discussed in the following two sections.

ATSDR's Process for Gathering Community Health Concerns

ATSDR carefully considers community members' health concerns that relate to a particular hazardous waste site as part of its public health assessment process. On June 23, 2009, environmental scientists and community specialists from ATSDR visited the McCormick community to conduct a site visit and a public availability session. During the site visit, ATSDR was provided with a walk-through of the site property by EPA in order to gain a better understanding of the impacted areas and the possible ways that people may come in contact with them. ATSDR also took a tour around the neighboring community.

On the evening of June 23, 2009 from 5pm to 7pm, ATSDR held a public availability session at the McCormick High School located at 516 Mims Drive in McCormick. ATSDR mailed a flyer announcing the meeting to the local churches, library, schools, colleges, daycare facilities, as well as the local hospital and medical offices. The Mayor and city council members were also provided with the flyer via e-mail or direct mail. In addition, a press release was issued to local newspapers and radio stations to announce ATSDR's public availability session.

The public availability session format offered community members an opportunity to meet with ATSDR representatives one-on-one to discuss their personal health concerns related to the site. All conversations were kept confidential. ATSDR also provided a brief overview of the public health assessment process at the session. Approximately 11 community members attended the public availability session.

Through discussions with people in the community, ATSDR did not record any specific health concerns that people had regarding the site. Instead, those in attendance were more interested in ATSDR's work and what they could expect from our efforts. In response, ATSDR provided information on its public health assessment process and

encouraged community members to contact ATSDR Barite Hill Site Team members if any health concerns should arise in the future regarding the site.

ATSDR's Public Comment Process

On May 11, 2010, ATSDR released the public comment version of the Barite Hill Site public health assessment. Over 100 letters were sent to local community members to communicate the findings of the public health assessment and inform people about ATSDR's process for gathering their input. Copies of the public comment public health assessment could be viewed on the ATSDR website or at the McCormick County Library located at 201 Railroad Avenue, McCormick, South Carolina. Community members could also request a personal copy by mail by contacting the ATSDR Barite Hill Site Team Lead (Annmarie DePasquale) at 770-488-0766. A 60-day period was provided for community members and government agencies to review the document and provide written comments to ATSDR that would be addressed in this final version of the public health assessment.

The public comment period began on May 11, 2010 and ended on July 12, 2010. In general, any official written comments submitted to ATSDR on public comment documents are addressed in the final version of the public health assessment. According to ATSDR's policy, the names of individuals who submit the comments on public health assessments are not printed in the final versions of the documents.

For the Barite Hill Site, no official comments were submitted to ATSDR.

Child Health Considerations

In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than adults from certain kinds of exposures to hazardous substances. Children play outdoors and typically engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than adults; this means they breathe dust, soil, and vapors close to the ground. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus adults need as much information as possible to make informed decisions regarding their children's health.

On the basis of the site-specific evaluation conducted in this public health assessment, ATSDR has determined that children are not known to come in contact with chemicals at the site. The site is located in a very remote location that is not easily accessible. Children would not be able to access the site on their own. The site is currently fenced and posted for no trespassing for the community. Parents are not expected to bring their children to the site to swim or play, based on the information available to ATSDR.

Conclusions & Public Health Action Plan

In the McCormick community, ATSDR's purpose is to serve the public using the best science, taking responsive public health actions, and providing trusted health information to prevent people from coming into contact with harmful substances. ATSDR's top priority is to ensure that the community has the best information possible to safeguard its health. ATSDR has become involved with the Barite Hill/Nevada Goldfields Site because Congress mandates that ATSDR conduct public health activities at Superfund sites that EPA proposes to its National Priority List (NPL). The Barite Hill Site was proposed to EPA's NPL in September 2008 and officially listed in April 2009.

ATSDR prepared this public health assessment to evaluate, based on the information currently available, any known or potential adverse human health hazards related to exposures to chemicals at the Barite Hill Site. ATSDR has reached several important conclusions about the Barite Hill Site in McCormick, South Carolina. ATSDR also makes recommendations for additional information needed to make public health conclusions that cannot be made at this time, based on the available information.

Conclusion 1

Many physical hazards exist at the site and people are urged not to trespass on site property. While trespassing is illegal and not recommended, ATSDR concludes that swimming in the surface water of the Main Pit is not likely to cause long-term health effects. Before treatment, the water was very acidic and may have caused some irritation of the skin and eyes for swimmers. However, long-term non-cancer and cancer health impacts are not likely to occur.

Basis

People could have swallowed small amounts of water that contained dissolved metals while swimming. However, the amount of these chemicals that could have gotten into the body is very small and not at levels expected to harm their health. The surface water was highly acidic before treatment and may have resulted in an irritation to the eyes and skin. As a result of neutralization treatment, many of the dissolved metals found in surface water samples before treatment have been found at much lower levels after treatment began and the water is no longer highly acidic.

Next steps

The site is fenced and "No Trespassing" signage has been posted by EPA on the perimeter fencing. No significant public health actions are needed regarding the conditions of the surface water in the Main Pit. However, it is recommended that EPA consider posting "No Swimming" signage inside the property boundary in the area of the Main Pit.

Conclusion 2	ATSDR concludes that people are not likely to come in contact with metals in sediment and surface water in the tributaries surrounding the site (Tributaries 1, 2, and 3) or in Hawe Creek.
Basis	While some metals have been found in surface water and sediment, the remote locations of Tributaries 1,2, 3 and Hawe Creek, as well as their shallow depth do not make these likely places for people to swim or play or come into frequent contact with these chemicals.
Next Steps	No public health actions are needed regarding people coming in contact with metals in surface water and sediment in Tributaries 1, 2, 3, and Hawe Creek. Please see Conclusion 5 for information on fish consumption from these surface water bodies.

Conclusion 3	ATSDR concludes that people living near the site are not exposed to unacceptable levels of chemicals in their drinking water supply, based on the available information.
Basis	A well survey conducted by EPA indicated that there were no homes in the immediate vicinity of the site that had private wells used for drinking water. Homes in the area receive their drinking water from a public water supply system that is routinely tested to ensure it meets the requirements of the Safe Drinking Water Act.
Next Steps	No public health actions are needed at this time regarding drinking water at homes in the vicinity of the site. Currently, EPA is collecting data on the groundwater conditions in the area of the site. When available, ATSDR will review this information and prepare additional public health documents, if the information changes the conclusions of this document.

Conclusion 4	ATSDR cannot currently conclude whether chemicals in surface soil could be harmful to people who trespass on the site.
Basis	ATSDR has received reports that trespassers may use four-wheelers at the site. ATSDR does not have the information necessary to determine whether this activity could be harmful to people's health.

Next Steps	ATSDR will work with EPA to acquire information on the chemical levels found in the areas of the site where people may use four-wheelers.

Conclusion 5	ATSDR cannot currently conclude whether fish species, collected from Tributaries 1, 2, 3, and Hawe Creek, contain levels of metals that are of concern for public health to people who may eat them.
Basis	ATSDR does not have fish tissue data available to evaluate at this time. However, it may be possible for some of the metals found in the tributaries and Hawe Creek to build up in some fish species over time.
Next Steps	ATSDR recommends that EPA collect information regarding the fishing activities of the community, such as where people fish and if these areas are impacted, what fish species are consumed and how frequently they are eaten. This may also involve the collection of fish tissue data, if needed.

Additional site-specific information, including environmental data, will become available from EPA in the future. EPA is currently studying the site and collecting environmental samples as part of its ongoing Remedial Investigation (RI) process. ATSDR may evaluate this new information and prepare supplemental public health documents, if the new information changes the conclusions of this document.

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APPENDIX A - ATSDR's EVALUATION PROCESS

Step 1 – Comparison Values and the Screening Process

To evaluate the available data, ATSDR used comparison values (CVs) to determine which chemicals to examine more closely. CVs are the chemical concentrations found in a specific media (for example: air, soil, or water) and are used to select chemicals for further evaluation. CVs incorporate assumptions of daily exposure to the chemical and a standard amount of air, soil, or water that someone may take into their body each day. CVs are generated to be conservative and non-site specific. These values are used only to screen out chemicals that do not need further evaluation. CVs are not intended as environmental clean-up levels or to indicate that health effects occur at concentrations that exceed these values. Because surface water CVs are not available, ATSDR used drinking water CVs in this public health assessment. This is a very health-protective approach as swimmers accidentally ingest a very small amount of water compared with the amount of drinking water that people consume from their homes each day.

CVs can be based on either carcinogenic (cancer-causing) or non-carcinogenic effects. Cancer-based comparison values are calculated from the U.S. Environmental Protection Agency's (EPA) oral cancer slope factor (CSF) or inhalation risk unit. CVs based on cancerous effects account for a lifetime exposure (70 years) with a theoretical excess lifetime cancer risk of 1 extra case per 1 million exposed people. Non-cancer values are calculated from ATSDR's Minimal Risk Levels (MRLs), EPA's Reference Doses (RfDs), or EPA's Reference Concentrations (RfCs). When a cancer and non-cancer CV exists for the same chemical, the lower of these values is used in the comparison for health protectiveness. The chemical and media-specific CVs utilized during the preparation of this public health assessment are listed below:

An **Environmental Media Evaluation Guide (EMEG)** is an estimated comparison concentration for which exposure is unlikely to cause adverse health effects, as determined by ATSDR from its toxicological profiles for a specific chemical.

A **Reference Dose Media Evaluation Guide (RMEG)** is an estimated comparison concentration that represents concentrations of chemicals (in water, soil, and air) to which humans may be exposed without experiencing adverse health effects.

A **Cancer Risk Evaluation Guide (CREG)** is a comparison concentration that is based on an excess cancer rate of one in a million persons and is calculated using EPA's cancer slope factor (CSF).

An **EPA Action Level** is the level of a chemical which, if exceeded, triggers water system treatment or other requirements.

Step 2 – Evaluation of Public Health Implications

The next step in the evaluation process is to take those chemicals that are detected at concentrations above their respective CVs and further identify the site-specific exposure situations and the likelihood that these exposures could pose a health hazard. Therefore, calculations are performed to estimate the possibility of cancer and non-cancer health impacts. The calculations consider the activities of people living in the community.

In this public health assessment, ATSDR has estimated potential exposure (via ingestion) of trespassers to chemicals in surface water in the Main Pit by calculating exposure doses and cancer risk estimates. The same equations have been used for the non-cancer and cancer calculations with the indicated modifications. Note that cancer risk calculated is expressed as the risk of an individual developing cancer over his or her lifetime. The equations and the assumptions are based on the ATSDR Public Health Assessment Guidance Manual[1], EPA Risk Assessment Guidance for Superfund, Part A[2], EPA Risk Assessment Guidance for Superfund, Part E[3], and the EPA Exposure Factors Handbook[4], unless otherwise specified. The assumptions and details on the non-cancer and cancer evaluations of exposure are presented in the following equations and text.

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Trespassers: Accidental Ingestion of Chemicals Present in Main Pit Surface Water During Swimming

The following equation was used to evaluate surface water exposures:

$$Dose\,(mg/kg/day) = \frac{C \times IR \times EF \times ED}{BW \times AT}$$

Where:

C = maximum detected concentration of a chemical; See Table 1; milligrams per liter (mg/L)

IR = ingestion rate; 0.0125 liters per hour (L/hour)

EF = exposure frequency; 10 days per year (days/year) equal to exposure 2 days per month for 5 months of warm weather

ED = exposure duration; 10 years

BW = body weight; 57 kilograms (kg) equal to approximately 125 pounds

AT = averaging time; 3,650 days for non-cancer and 25,550 days for cancer evaluation

Non-Cancer Health Effects

The doses calculated for exposure to each individual chemical are then compared to established health guidelines, such as ATSDR's Minimal Risk Levels (MRLs) or EPA's Reference Doses (RfDs), in order to assess whether adverse non-cancer health impacts from exposure are expected. These health guidelines, described in more detail in the following text, are chemical-specific values that are based on the available scientific literature and are considered protective of human health.

Minimal Risk Levels (MRLs)

ATSDR has developed MRLs for contaminants commonly found at hazardous waste sites. The MRL is an estimate of daily exposure to a contaminant below which non-cancer, adverse health effects are unlikely to occur. MRLs are developed for different routes of exposure, such as inhalation and ingestion, and for lengths of exposure, such as acute (less than 14 days), intermediate (15-364 days), and chronic (365 days or greater). At this time, ATSDR has not developed MRLs for dermal exposure. A complete list of the available MRLs can be found at http://www.atsdr.cdc.gov/mrls.html. For this public health assessment, ATSDR utilized Oral MRLs for chronic exposures when possible. Oral Intermediate MRLs were used when chronic MRLs were unavailable.

References Doses (RfDs)

An estimate of the daily, lifetime exposure of human populations to a possible hazard that is not likely to cause non-cancerous health effects. RfDs consider exposures to sensitive sub-populations, such as the elderly, children, and the developing fetus. EPA's RfDs have been developed using information from the available scientific literature and have been calculated for oral and inhalation exposures. A complete list of the available RfDs can be found at http://www.epa.gov/iris.

Non-carcinogenic effects, unlike carcinogenic effects, are believed to have a threshold, that is, a dose below which adverse health effects will not occur. As a result, the current practice for deriving health guidelines is to identify, usually from animal toxicology experiments, a No Observed Adverse Effect Level (or NOAEL), which indicates that no effects are observed at a particular exposure level. This is the experimental exposure level in animals (and sometimes humans) at which no adverse toxic effect is observed. The NOAEL is then modified with an uncertainty (or safety) factor, which reflects the degree of uncertainty that exists when experimental animal data are extrapolated (or applied) to the general human population. The magnitude of the uncertainty factor considers various factors such as sensitive subpopulations (for example; children, pregnant women, and the elderly), extrapolation from animals to humans, and the completeness of available data. Thus, exposure doses at or below the established health guideline are not expected to result in adverse non-cancer health effects.

When site-specific exposure doses exceed health guidelines, it does not necessarily indicate that health effects will occur. Rather, it indicates that a more thorough look at the known toxicological values for the chemical and the site-related exposures are needed. The known toxicological values are doses derived from human and animal studies that are presented in the ATSDR Toxicological Profiles and EPA's Integrated Risk Information System (IRIS). A direct comparison of site-specific exposure doses to study-derived exposures and doses found to cause adverse health effects is the basis for deciding whether health effects are likely to occur. This in-depth evaluation is performed by comparing calculated exposure doses with known toxicological values, such as the no-observed adverse-effect-level (NOAEL) and the lowest-observed-adverse-effect-level (LOAEL) from studies used to derive the MRL or RfD for a chemical. Because none of the exposure doses calculated for Barite Hill exceeded health guidelines, a more in-depth review of the NOAEL and LOAELs was not completed in this public health assessment.

It is important to consider that the methodology used to develop these health guidelines does not provide any information on the presence, absence, or level of cancer risk. Therefore, a separate cancer evaluation is necessary for potentially cancer-causing chemicals detected in samples at this site. A more detailed discussion of the evaluation of cancer risks is presented in the following section.

Cancer Risks

The estimated excess risk of developing cancer from exposure to chemicals associated with arsenic at the site was calculated by multiplying the site-specific trespasser exposure doses, with a slight modification, by EPA's oral cancer slope factor (CSFs or cancer potency estimates) for arsenic of 1.5 $(mg/kg/day)^{-1}$, which is available on the EPA Integrated Risk Information System (IRIS) at http://www.epa.gov/iris/subst/0278.htm.

Note that cancer risk calculated for exposures occurring during adulthood and childhood are combined and expressed as the risk of an individual developing cancer over his or her lifetime. An increased excess lifetime cancer risk is not a specific estimate of expected cancers. Rather, it is an estimate of the increase in the probability that a person may develop cancer sometime during his or her lifetime following exposure to a particular chemical. Therefore, the cancer risk calculation incorporates the equations and parameters (including the exposure duration and frequency) used to calculate the dose estimates, but the estimated value is divided by 25,550 days (or the averaging time), which is equal to a lifetime of exposure (70 years) for 365 days/year.

There are varying suggestions among the scientific community regarding an acceptable excess lifetime cancer risk, due to the uncertainties regarding the mechanism of cancer. The recommendations of many scientists, as well as ATSDR and EPA, have been in the risk range of 1 in 1 million to 1 in 10,000 (as referred to as 1×10^{-6} to 1×10^{-4}) excess cancer cases. An increased lifetime cancer risk of one in one million or less is generally considered an insignificant increase in cancer risk. Cancer risk less than 1 in 10,000 (or 1×10^{-4}) is not typically considered a health concern. An important consideration when determining cancer risk estimates is that the risk calculations incorporate several very conservative assumptions that are expected to overestimate actual exposure scenarios. For example, the method used to calculate EPA's CSFs assumes that high-dose animal data can be used to estimate the risk for low dose exposures in humans. As previously stated, the method also assumes that there is no safe level for exposure. Lastly, the method computes the 95% upper bound for the risk, rather than the average risk, suggesting that the cancer risk is actually lower, perhaps by several orders of magnitude.

Because of the uncertainties involved with estimating cancer risk, ATSDR also employs a qualitative approach in evaluating all relevant data. The actual environmental exposures have been given careful and thorough consideration in evaluating the assumptions and variables relating to both toxicity and exposure. A complete review of the toxicological data regarding the doses associated with the production of cancer and the site-specific doses is an important element in determining the likelihood of exposed individuals being at a greater risk for cancer.

ATSDR's cancer assessment for the Barite Hill Site focuses on accidental ingestion of arsenic while swimming in surface water in the Main Pit by occasional trespassers. An insignificant cancer risk is expected to be associated with these exposures.

ATSDR Glossary of Environmental Health Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health. This glossary defines some of the words used by ATSDR in communications with the public.

Absorption - The process of taking in. For a person or animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Acute exposure - Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with intermediate duration exposure and chronic exposure].

Adverse health effect - A change in body function or cell structure that might lead to disease or health problems.

Background level - An average or expected amount of a substance in a specific environment, or typical amounts of substances that occur naturally in an environment.

Biologic uptake - The transfer of substances from the environment to plants, animals, and humans.

Biota - Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

Cancer - Any one of a group of diseases that occurs when cells in the body become abnormal and grow or multiply out of control.

Cancer risk - A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen - A substance that causes cancer.

Chronic exposure - Contact with a substance that occurs over a long time (more than 1 year).

Comparison value (CV) - Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) - CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances.

Concentration - The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant - A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Dermal contact - Contact with (touching) the skin.

Dose - The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An exposure dose is how much of a substance is encountered in the environment. An absorbed dose is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose-response relationship - The relationship between the amount of exposure [dose] to a substance and the resulting changes in body function or health (response).

Environmental media - soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism - Environmental media include water, air, soil, and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The environmental media and transport mechanism is the second part of an exposure pathway.

EPA - United States Environmental Protection Agency

Exposure - Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].

Exposure assessment - The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure pathway - The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching); and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

Groundwater - Water beneath the earth's surface in the spaces between soil particles and between rock surfaces.

Hazard - A source of potential harm from past, current, or future exposures.

Hazardous waste - Potentially harmful substances that have been released or discarded into the environment.

Ingestion - The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way.

Inhalation - The act of breathing. A hazardous substance can enter the body this way.

Intermediate duration exposure - Contact with a substance that occurs for more than 14 days and less than a year.

Lowest-observed-adverse-effect level (LOAEL) - The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Migration - Moving from one location to another.

Minimal risk level (MRL) - An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects.

National Priorities List (or NPL) – EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

No-observed-adverse-effect level (NOAEL) - The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

Point of exposure - The place where someone can come into contact with a substance present in the environment.

Prevention - Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

Public comment period - An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public availability session - An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public health action - A list of steps to protect public health.

Public health assessment (PHA) - An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health.

Reference dose (RfD) - An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Remedial investigation - The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Sample - A portion or piece of a whole. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Source of contamination - The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an exposure pathway.

Substance - A chemical.

Surface water - Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].

Survey - A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment.

Toxicological profile - An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology - The study of the harmful effects of substances on humans or animals.

Uncertainty factor - Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk

level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. They are also sometimes called a safety factor.